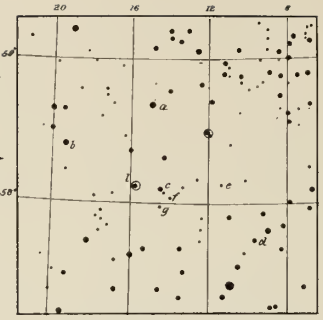
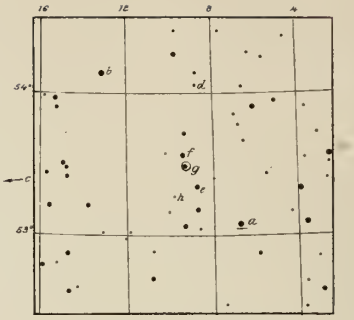
107 *T Cassiopeiæ.*
R.A. $0^h 17^m 8$ DEC. $+55°14'$

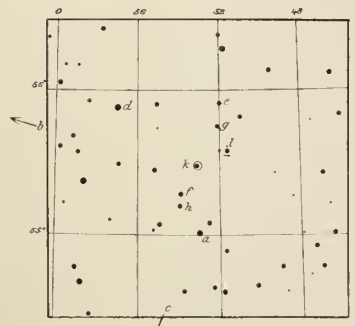
432 *S Cassiopeiæ.*
R.A. $1^h 12^m 3$ DEC. $+72°5'$



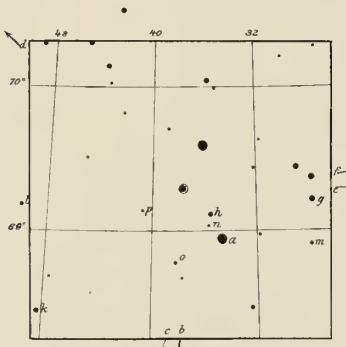
793 and 814, *T* and *S Persei.*
R.A. $2^h 12^m 2$ DEC. $+58°29'$
$2^h 15^m 7$ $58°8'$



1855 *R Aurigæ.*
R.A. $5^h 9^m 2$ DEC. $+53°29'$

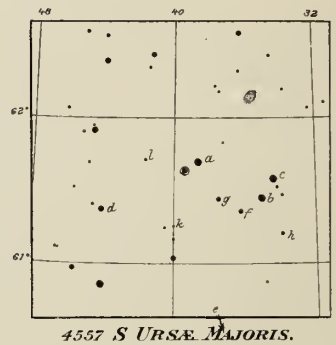


2478 *R. Lyncis.*
R.A. $6^h 53^m 1$ DEC. $+55°29'$

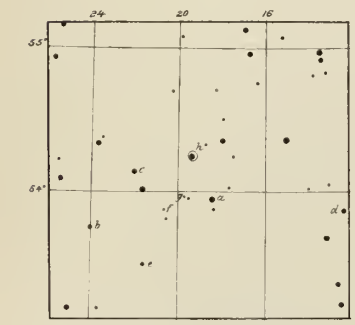


3825 *R. Ursæ Majoris.*
R.A. $10^h 37^m 6$ DEC. $+69°18'$

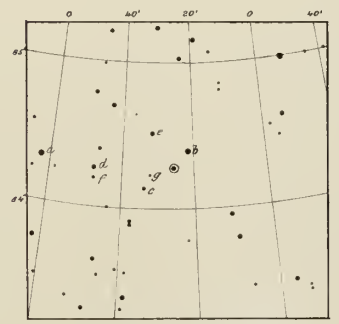
4511 *T Ursæ Majoris.*
R.A. $12^h 31^m 9$ DEC. $+60°3'$



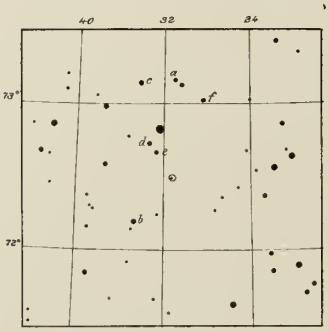
4557 *S Ursæ Majoris.*
R.A. $12^h 39^m 6$ DEC. $+61°39'$



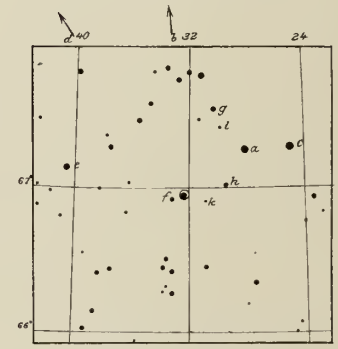
5137 *S Bootis.*
R.A. $14^h 19^m 5$ DEC. $+54°16'$



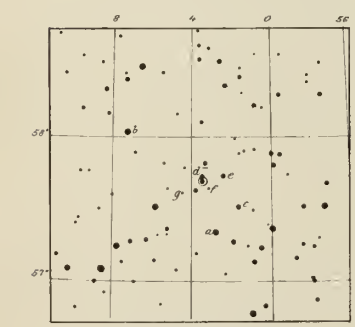
5190 *R Camelopardi.*
R.A. $14^h 25^m 1$ DEC. $+84°17'$



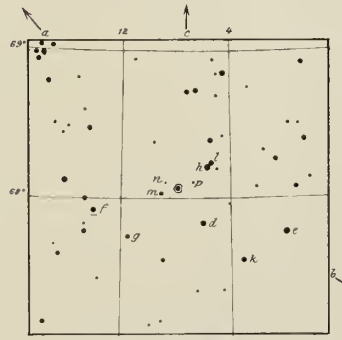
5948 *R Ursæ Minoris.*
R.A. $16^h 31^m 3$ DEC. $+72°29'$



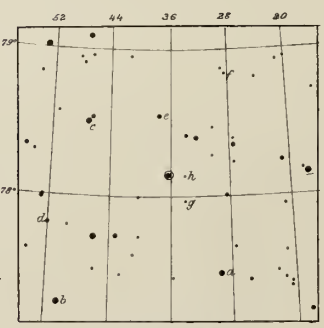
5955 *R Draconis.*
R.A. $16^h 32^m 4$ DEC. $+66°58'$



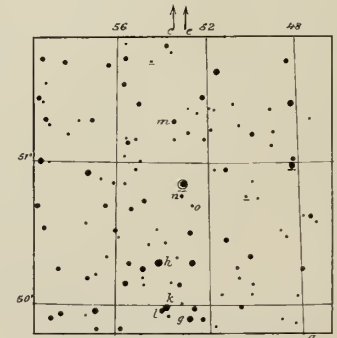
7220 *S Cygni.*
R.A. $20^h 3^m 4$ DEC. $+57°42'$



7609 *T Cephei.*
R.A. $21^h 8^m 2$ DEC. $+68°5'$



7779 *S Cephei.*
R.A. $21^h 36^m 5$ DEC. $+78°10'$



8600 *R Cassiopeiæ.*
R.A. $23^h 53^m 3$ DEC. $+50°50'$

CIRCUMPOLAR VARIABLES.

THE ASTRONOMICAL OBSERVATORY OF HARVARD COLLEGE.

EDWARD C. PICKERING, DIRECTOR.

VARIABLE STARS

OF

LONG PERIOD.

CAMBRIDGE:
JOHN WILSON AND SON.
University Press.
1891.

VARIABLE STARS OF LONG PERIOD.

A NATURAL classification of the variable stars seems to place together those having a period of one or two years. They have many points in common; for instance, when near maximum the lines in their spectra due to hydrogen are usually bright. This peculiarity has in several cases led to their discovery, and perhaps furnishes a clue to the cause of their variation in light. Their color is generally red, and the change in brightness very great. Several of them at maximum are visible to the naked eye, but at minimum become wholly invisible, or at least beyond the reach of any but the largest telescopes. This variation is as great as that between the brightest and faintest stars visible to the naked eye. Numerous observations have been made of many of these stars, but generally with the object of determining the times at which they attain their greatest brilliancy. The nature of the changes, or form of light curve, as it is called, has been comparatively neglected. It is the object of the present paper to provide a means of supplying this omission.

Many astronomers, provided in some cases with excellent telescopes, find difficulty in using them in such a way as will really advance astronomical science. The study of these variables seems especially adapted to such cases. Except the telescope itself, no delicate apparatus, like clock-work or micrometer, is required. Even divided circles are not essential, although they facilitate observation. The variation in brightness is also so great that even rough measures will have a value, since the laws regulating many of these variables are almost entirely unknown. When the total change in brightness is small, great skill is required to determine variations with accuracy. But less precision is needed when the variations amount to several magnitudes, especially as great accuracy seems to be unattainable owing to the color of these stars.

The best method of making the observation is that invented by Sir William Herschel, and developed by Argelander. The variable is compared with a known star of very nearly the same brightness, and the difference, if any, is estimated. If two stars of equal brightness are watched for a few seconds, the relative brightness will appear to vary. If one appears the brighter as often as the other, they may be

assumed to be equal. If, however, one appears brighter oftener than the other does, the difference in brightness may be regarded as one grade or step. In actual practice this difference in brightness is found to be nearly constant for different persons, and to be a little greater than one tenth of a stellar magnitude. When one star generally appears brighter, but sometimes the stars appear equal, the difference is two steps. If one star always seems brighter than the other, while the difference always remains small, this difference may be regarded as three steps. Somewhat larger intervals may be estimated, but with less accuracy, and should be avoided as far as possible. To study the changes in light of a variable star it is only necessary to select a series of comparison stars, and compare the variable with stars of nearly the same brightness taken from this series. If possible, two comparison stars should be used, one a little brighter, the other a little fainter than the variable. Evidently the comparison stars should be near the variable, and a very low power should be used, so that the apparent distance may be small. Double stars and those near brighter stars should not be used for comparison stars, since otherwise large errors will be introduced, whose amount will vary with the instrument used. Since a star near the edge of the field of a telescope appears brighter than when near the centre, it is better to bring each star in turn into the centre, rather than to place them equally near the edge of the field. When the distance between two stars is so small that they cannot readily be observed alternately, as just recommended, it is probable that, owing to the varying sensitiveness of different portions of the retina, their relative brightness will appear to vary according to their position. The head should therefore always be turned until the line connecting the eyes is parallel to that connecting the stars, in order that the error may be the same in all cases. Its amount may be determined by selecting several pairs of stars such that in each pair the stars shall be nearly equal in brightness and one over the other. Compare these stars with the upper stars in the successive pairs alternately to the right and left, and repeat with the head turned the opposite way, so that each pair is measured once with the upper star to the right and once to the left. The mean of the differences of the results when the upper star is turned to the right and to the left will equal twice the error due to their position. When the variable is bright the comparison should also be made with the finder, with a field-glass, or with the unaided eye, since it is difficult to compare two very bright images.

An observation is made by directing the telescope to the proper region by means of its declination and hour circles. If no circles are provided, the region can generally be easily found by the help of any good star atlas (Heis, Atlas Coelestis Novus; Klein, Star Atlas). When the variable is bright it can sometimes

be recognized by its color, but generally a map of the fainter stars is required. The atlas of the Durchmusterung is best suited to this purpose. The comparison stars should be selected once for all and marked on the map, by assigning a letter to each in the order of brightness. The brightest should be somewhat brighter than the variable at maximum, and the interval between the successive stars, when arranged in the order of their brightness, should not exceed half a magnitude. The variable should then be compared with the two stars nearest it in brightness, one brighter, the other fainter. If it is found convenient to use an additional comparison star, the latter should always be compared, like the variable, with two of the stars first selected. This should be done independently, on at least three evenings, and on a greater number if the new star is frequently compared with the variable. If one of the comparison stars appears to have changed, it should frequently be compared with some other star nearly equal to it in brightness. To give an idea of the interval of one magnitude, the stars α, γ, δ, θ and λ *Ursæ Minoris* may be examined. Their magnitudes, according to the Harvard Photometry, are 2.2, 3.2, 4.3, 5.3, and 6.5, respectively, and therefore differ by very nearly one magnitude. It is very good practice to select several stars intermediate in brightness between these, arrange them in the order of brightness, and estimate the intervals in grades. The value of a grade may thus be determined directly. For instance, if we find δ 1 grade brighter than ϵ *Ursæ Minoris*, ϵ 4 grades brighter than η, and η 2 grades brighter than θ, we may conclude that δ is 7 grades brighter than θ, an interval which, according to the photometer, equals 1.0 magnitude. One grade will then equal 0.14 magnitude.

The record of the observation of a variable star should consist of the name of the observer, the instrument employed, giving the aperture, magnifying power, diameter of field, etc.; the date (regarding the day as beginning at noon, so that after midnight the date is that of the evening before); the hour and minute, stating what time is used, as local, Greenwich, Standard, Central, etc.; the comparisons; the name of the variable, and any general remarks, as hazy, twilight strong, difficult owing to the proximity of the Moon, etc. The comparisons consist of the letters designating the stars, separated by a number giving the interval, the brighter star being always named first. The letter designating the star which is to the right when the eyes are placed parallel to the stars should be underlined. Thus a 2 V, V 3 b denotes that the star a appeared to be 2 grades brighter than the variable, and the variable 3 grades brighter than the star b; also, that in both cases the position of the head was such that the variable was to the right of the comparison star.

Observations have been in progress for some time at the Harvard College Observatory on the seventeen variables enumerated below, which are north of + 50°. They were selected since they are always above the horizon in a large part of Europe and the United States. The name of the variable, its right ascension for 1900, declination for 1900, maximum brightness, minimum brightness, and period are given in Table I.

TABLE I.

VARIABLE STARS OF LONG PERIOD.

Name.	R A. 1900.	Dec. 1900.	Max.	Min.	Period.
	h. *m.*	° ′			
T Cassiopeiæ . .	0 17.8	+55 14	7.0	12.1	441
S Cassiopeiæ . .	1 12.3	+72 5	6.7	15.1	607.5
T Persei	2 12.2	+58 29	8.2	9.5	—
S Persei	2 15.7	+58 8	7.6	12.5	346
R Aurigæ . . .	5 9.2	+53 29	6.5	<13	460.6
R Lyncis	6 53.1	+55 29	7.8	14.8	380.0
R Ursæ Majoris	10 37.6	+69 18	6.0	13.2	297
T Ursæ Majoris	12 31.9	+60 3	6.7	<13	257.2
S Ursæ Majoris	12 39.6	+61 39	7.0	12.5	237
S Boötis	14 19.5	+54 16	7.7	13.8	272.3
R Camelopardi	14 25.1	+84 17	7.8	14.1	269.5
R Ursæ Minoris	16 31.3	+72 29	8.6	10.5	180
R Draconis . . .	16 32.4	+66 58	6.5	13.1	245.9
S Cygni	20 3.4	+57 42	8.8	<15	318
T Cephei	21 8.2	+68 5	5.6	10.4	383.2
S Cephei	21 36.5	+78 10	7.4	12.8	484
R Cassiopeiæ .	23 53.3	+50 50	4.8	12.7	429.0

A careful selection of suitable comparison stars has been made by Mr. O. C. Wendell with the 15-inch telescope. Precedence was given to stars nearest the variable. Arranging them in the order of brightness the intervals should be nearly half a magnitude, but should not exceed this amount. Double stars were excluded, and no star used when a brighter star was near. A revision of this list was made by Mr. W. M. Reed, with the 6-inch telescope, to see if all of the stars selected which were sufficiently bright could be used with a smaller instrument and lower magnifying power. No stars were retained which could not be conveniently observed with either instrument. These stars are enumerated in Table II. A letter used to designate each star is followed by the approximate right ascension for 1900, declination for 1900, and magnitude. The latter is given only to the nearest unit to indicate the approximate brightness, which may serve to identify the star. The variables S and T *Persei* are so near together that the same comparison stars may be used for both.

TABLE II.

COMPARISON STARS.

T Cassiopeiæ.

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
a	0 39.6	+54 41	6
b	0 21.2	+56 5	6
c	0 20.8	+56 13	7
d	0 20.6	+54 56	7
e	0 18.0	+55 15	8
f	0 18.3	+54 50	8
g	0 18.9	+55 2	8
h	0 20.5	+55 10	9
k	0 21.1	+55 14	9
l	0 16.1	+55 11	10
m	0 19.5	+55 10	10
n	0 18.0	+55 20	11
o	0 18.3	+55 20	12
p	0 17.7	+55 11	12
q	0 18.2	+55 16	13
r	0 17.7	+55 12	13
s	0 17.9	+55 13	14
t	0 18.0	+55 14	14
u	0 17.7	+55 12	14
w	0 17.8	+55 13	15
T	0 17.8	+55 14	var.

S Cassiopeiæ.

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
a	0 41.6	+72 8	6
b	1 11.4	+71 52	7
c	1 11.2	+72 20	7
d	0 44.3	+73 1	8
e	1 23.2	+72 22	8
f	1 24.5	+72 24	8
g	1 7.0	+71 58	9
h	0 56.1	+72 50	9
k	1 12.7	+72 2	10
l	1 13.4	+72 4	10
m	1 11.6	+72 12	10
n	1 13.8	+71 52	11
o	1 12.8	+71 50	11
p	1 13.0	+71 59	12
q	1 14.4	+72 6	12

S Cassiopeiæ. — *Cont.*

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
r	1 12.2	+72 0	12
s	1 12.9	+72 13	13
t	1 12.2	+72 6	13
u	1 11.8	+72 5	14
w	1 12.0	+72 5	14
x	1 12.9	+72 6	15
y	1 12.5	+72 6	15
S	1 12.3	+72 5	var.

S and T Persei.

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
a	2 15.1	+58 43	8
b	2 19.5	+58 25	8
c	2 14.6	+58 7	8
d	2 9.6	+57 45	9
e	2 11.4	+58 8	9
f	2 14.0	+58 2	9
g	2 14.3	+57 58	10
h	2 13.6	+58 2	11
k	2 15.9	+58 14	11
l	2 15.7	+58 9	12
m	2 15.6	+58 4	12
n	2 15.6	+58 0	12
o	2 15.4	+58 0	13
p	2 15.8	+58 10	14
q	2 15.9	+58 6	14
r	2 15.3	+58 6	14
s	2 15.6	+58 5	15
S	2 15.7	+58 8	var.
T	2 12.2	+58 29	var.

R Aurigæ.

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
a	5 6.7	+53 6	6
b	5 13.2	+54 9	7
c	5 21.8	+53 20	7
d	5 8.9	+54 4	8

R Aurigæ. — *Cont.*

Des.	R. A. 1900. h m.	Dec. 1900. ° ′	Mag.
e	5 8.7	+53 22	8
f	5 9.5	+53 35	9
g	5 9.1	+53 29	9
h	5 9.8	+53 17	10
k	5 8.4	+53 23	10
l	5 9.8	+53 24	11
m	5 9.1	+53 20	11
n	5 8.3	+53 30	11
o	5 8.3	+53 19	12
p	5 8.9	+53 34	12
q	5 9.0	+53 29	13
r	5 9.7	+53 29	13
s	5 9.8	+53 28	14
t	5 9.5	+53 28	14
u	5 9.6	+53 28	15
R	5 9.2	+53 29	var.

R Lyncis.

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
a	6 53.1	+54 59	7
b	7 3.3	+55 47	7
c	6 55.0	+54 19	8
d	6 56.9	+55 52	8
e	6 51.9	+55 53	9
f	6 53.9	+55 15	9
g	6 52.0	+55 45	10
h	6 54.0	+55 10	10
k	6 53.5	+55 30	10
l	6 51.6	+55 34	11
m	6 52.9	+55 32	11
n	6 51.8	+55 28	12
o	6 52.3	+55 33	12
p	6 52.6	+55 30	12
q	6 53.2	+55 32	13
r	6 52.7	+55 29	14
s	6 52.8	+55 30	14
t	6 53.1	+55 27	14
u	6 53.3	+55 32	15
R	6 53.1	+55 28	var.

R Ursæ Majoris.

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
a	10 34.8	+68 57	6
b	10 38.2	+67 56	6
c	10 42.1	+65 40	6
d	10 56.8	+70 35	7
e	10 1.7	+69 10	7
f	10 14.5	+69 26	7
g	10 27.6	+69 13	8
h	10 35.4	+69 8	8
k	10 48.5	+68 28	9
l	10 49.6	+69 6	9
m	10 27.7	+68 54	9
n	10 35.5	+69 4	9
o	10 38.1	+68 48	10
p	10 40.5	+69 9	10
q	10 40.5	+69 22	11
r	10 37.7	+69 21	11
s	10 37.0	+69 17	12
t	10 37.6	+69 15	12
u	10 36.7	+69 15	12
w	10 38.8	+69 18	13
x	10 38.2	+69 20	14
y	10 37.0	+69 19	14
z	10 37.9	+69 16	14
α	10 38.1	+69 19	15
R	10 37.6	+69 18	var.

T Ursæ Majoris.

Des.	R. A. 1900. h. m.	Dec. 1900. ° ′	Mag.
a	12 25.4	+59 19	6
b	12 35.1	+61 26	7
c	12 34.5	+61 34	7
d	12 44.2	+61 22	8
e	12 35.9	+60 5	8
f	12 34.7	+60 18	8
g	12 32.8	+59 46	9
h	12 29.6	+60 17	9
k	12 34.0	+60 15	9
l	12 33.9	+60 10	10
m	12 34.3	+60 4	10
n	12 33.4	+59 52	10

T Urs. Maj. — *Cont.*

Des.	R. A. 1900.	Dec. 1900.	Mag.
	h. m	° ′	
o	12 33.9	+59 52	11
p	12 34.8	+60 8	12
q	12 31.3	+60 4	12
r	12 32.8	+59 58	12
s	12 34.2	+59 59	13
t	12 32.1	+60 0	14
u	12 33.1	+59 59	14
w	12 32.2	+60 1	14
x	12 32.5	+60 2	15
y	12 31.9	+59 59	15
T	12 31.9	+60 2	var.

S Ursæ Majoris.

a	12 38.7	+61 42	6
b	12 35.1	+61 26	7
c	12 34.5	+61 34	7
d	12 44.2	+61 22	8
e	12 35.9	+60 5	8
f	12 36.4	+61 22	9
g	12 37.7	+61 25	9
h	12 33.8	+61 12	10
k	12 40.2	+61 15	10
l	12 41.7	+61 40	10
m	12 40.6	+61 33	11
n	12 40.6	+61 44	12
o	12 41.2	+61 33	12
p	12 41.7	+61 32	12
q	12 41.4	+61 36	13
r	12 37.5	+61 36	13
s	12 40.2	+61 39	14
t	12 40.4	+61 41	14
u	12 40.2	+61 41	14
w	12 40.1	+61 40	15
S	12 39.6	+61 38	var.

S Boötis.

a	14 18.6	+53 59	7
b	14 24.0	+53 45	8
c	14 22.3	+54 10	8

S Boötis. — *Cont.*

Des.	R. A. 1900.	Dec. 1900.	Mag.
	h. m.	° ′	
d	14 12.4	+53 56	9
e	14 21.5	+53 32	9
f	14 21.0	+53 55	10
g	14 19.8	+54 1	10
h	14 18.9	+54 21	11
k	14 22.4	+54 17	11
l	14 21.7	+54 13	12
m	14 19.4	+54 20	12
n	14 19.8	+54 11	12
o	14 19.3	+54 19	13
p	14 19.3	+54 23	14
q	14 19.1	+54 18	14
r	14 19.5	+54 10	14
s	14 19.9	+54 17	15
S	14 19.5	+54 16	var.

R Camelopardi.

a	15 1.6	+84 20	8
b	14 21.4	+84 24	8
c	14 32.3	+84 10	9
d	14 46.8	+84 17	9
e	14 31.2	+84 34	10
f	14 45.8	+84 14	10
g	14 30.8	+84 15	11
h	14 28.8	+84 23	11
k	14 17.8	+84 29	12
l	14 31.3	+84 21	12
m	14 22.5	+84 16	13
n	14 13.3	+84 12	13
o	14 18.8	+84 17	14
p	14 24.2	+84 11	14
q	14 26.5	+84 12	14
r	14 26.6	+84 14	15
R	14 24.9	+84 17	var.

R Ursæ Minoris.

a	16 31.3	+73 9	8
b	16 35.2	+72 11	8
c	16 34.8	+73 9	9

R Urs. Min. — *Cont.*

Des.	R. A. 1900.	Dec. 1900.	Mag.
	h. m.	° ′	
d	16 33.6	+72 44	9
e	16 33.2	+72 40	10
f	16 28.7	+73 1	10
g	16 34.9	+72 46	10
h	16 33.6	+72 22	11
k	16 34.9	+72 20	11
l	16 31.0	+72 14	12
R	16 31.3	+72 29	var.

R Draconis.

a	16 28.1	+67 16	7
b	16 34.0	+68 13	7
c	16 25.0	+67 16	7
d	16 42.9	+68 17	8
e	16 40.8	+67 9	8
f	16 33.2	+66 55	8
g	16 30.2	+67 34	9
h	16 29.6	+67 1	9
k	16 31.0	+66 56	10
l	16 29.9	+67 27	10
m	16 33.4	+67 6	10
n	16 32.8	+66 49	11
o	16 32.4	+66 48	12
p	16 34.2	+66 59	12
q	16 32.6	+66 55	12
r	16 33.5	+66 57	12
s	16 33.3	+66 50	13
t	16 34.2	+67 1	14
u	16 32.6	+66 56	14
w	16 32.6	+66 59	14
x	16 32.6	+67 0	15
R	16 32.4	+66 58	var.

S Cygni.

a	20 2.6	+57 20	8
b	20 7.0	+58 2	8
c	20 1.4	+57 32	9
d	20 3.5	+57 43	9
e	20 2.3	+57 44	10

S Cygni. — *Cont.*

Des.	R. A. 1900.	Dec. 1900.	Mag.
	h. m.	° ′	
f	20 3.0	+57 40	10
g	20 4.3	+57 37	10
h	20 3.6	+57 32	11
k	20 3.8	+57 36	11
l	20 3.6	+57 40	11
m	20 3.5	+57 48	12
n	20 3.6	+57 49	13
o	20 3.6	+57 45	13
p	20 3.5	+57 39	14
q	20 2.8	+57 47	14
r	20 3.6	+57 43	14
s	20 3.8	+57 41	15
t	20 3.6	+57 43	15
S	20 3.4	+57 42	var.

T Cephei.

a	21 40.5	+70 50	5
b	20 41.9	+66 18	6
c	21 5.8	+71 2	6
d	21 6.4	+67 51	7
e	21 0.4	+67 47	7
f	21 14.3	+67 56	8
g	21 11.9	+67 44	8
h	21 6.1	+68 12	8
k	21 3.7	+67 35	9
l	21 5.7	+68 15	9
m	21 10.0	+68 1	10
n	21 9.1	+68 8	10
o	21 6.6	+68 8	10
p	21 7.2	+68 4	10
q	21 7.6	+68 12	11
r	21 6.4	+68 2	12
s	21 10.7	+68 12	12
t	21 9.7	+68 14	12
T	21 8.2	+68 5	var.

S Cephei.

a	21 29.9	+77 30	7
b	21 50.9	+77 18	8

Des.	R. A. 1900.	Dec. 1900.	Mag.
S Cephei. — *Cont.*			
	h. *m.*	° ′	
c	21 47.1	+78 34	8
d	21 52.7	+77 52	9
e	21 37.8	+78 37	9
f	21 28.7	+78 53	9
g	21 34.3	+78 1	10
h	21 34.3	+78 11	10
k	21 40.7	+78 11	10
l	21 42.2	+78 13	11
m	21 36.2	+78 4	12
n	21 39.1	+78 13	12
o	21 35.0	+78 8	12
p	21 37.5	+78 14	13
S Cephei. — *Cont.*			
q	21 38.8	+78 4	14
r	21 37.8	+78 11	14
s	21 37.4	+78 10	14
t	21 37.7	+78 10	15
S	21 36.5	+78 10	var.
R Cassiopeiæ.			
a	23 32.6	+45 56	4
b	23 35.5	+43 46	4
R Cassiopeiæ. — *Cont.*			
c	23 53.9	+55 12	5
d	0 5.1	+45 31	5
e	23 52.1	+55 9	6
f	23 56.3	+49 25	6
g	23 53.1	+49 53	7
h	23 54.5	+50 17	7
k	23 54.2	+49 58	8
l	23 54.3	+49 57	8
m	23 53.9	+51 16	9
n	23 53.5	+50 46	9
o	23 53.0	+50 41	10
p	23 54.1	+50 52	10
R Cassiopeiæ. — *Cont.*			
q	23 53.8	+50 45	10
r	23 53.3	+50 50	11
s	23 54.1	+50 48	11
t	23 53.1	+50 54	12
u	23 53.5	+50 48	12
w	23 53.2	+50 53	12
x	23 53.7	+50 54	13
y	23 53.4	+50 51	13
z	23 53.3	+50 52	14
α	23 53.4	+50 49	14
β	23 53.2	+50 49	15
R	23 53.3	+50 50	var.

The plate accompanying this pamphlet contains charts of the regions surrounding these variables. They are copied from the Atlas of the Durchmusterung. Each region is two degrees square, with the variable in the center, except in the case of S and T *Persei*. The comparison stars are indicated by the same letters as in Table II., and when they fall outside of the charts arrows are used to indicate their direction.

Observations of these variable stars are much to be desired, in order that the results may be compared with those obtained at Cambridge. All seventeen may be observed in two or three hours with proper appliances and practice. If such observations could be made several times a month by a number of observers, we could determine whether apparent sudden changes in light were due to errors of observation, or to actual variations in the star. If observers with large telescopes would undertake to follow these stars when beyond the reach of ordinary instruments, we should obtain valuable results regarding the light at minimum. Astronomers observing these variables and desiring to use other comparison stars are invited to connect them with the series of stars given in Table II., that all may be reduced to the same system. Photometric measures of the light of the comparison stars, especially those that are faint, are particularly desired, for comparison with the results obtained at Cambridge. Estimates of the difference in the successive stars of Table II. are desired for the same reason. Similar estimates of the difference in brightness of the fainter stars in the different series will serve to reduce the scale of magnitudes of all to the same system. All persons observing the variables or comparison stars according to the system described above are invited to send their results to

Cambridge for reduction and publication on the same system as our own observations. It is hoped that all can be reduced to a uniform scale of magnitude, and thus indicate the nature of the variations of the stars much better than we now know it. Should this work commend itself to astronomers, it is hoped to extend it to the other variables of long period.

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